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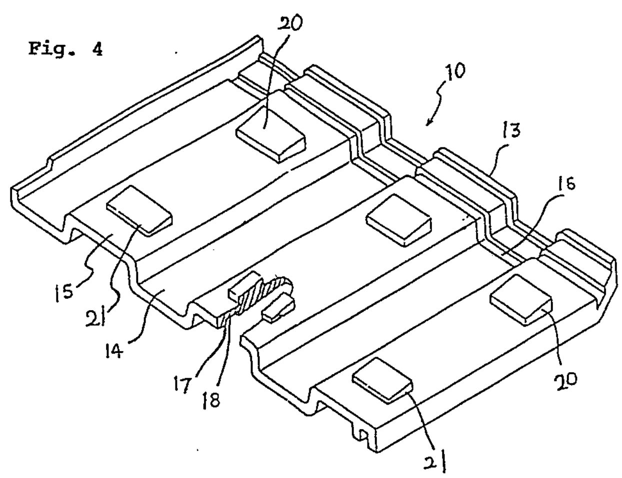
(54) A cement tile reinforced with fibers and a method for the production of the same.

(57) A cement tile (10) reinforced with fibers having, per 100 parts by weight of cement, 0.3-7 parts by weight of synthetic fibers as reinforcing materials, and 200 parts by weight or less of an inorganic filler, wherein the tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley (14) of the tile being 5-30% thicker than the hill (15), and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand (20, 21), and a method for the manufacture of the said tile.

Fig. 4



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Description

A CEMENT TILE REINFORCED WITH FIBERS AND A METHOD FOR THE PRODUTION OF THE SAME

This invention relates to a tile that is made of cement and reinforced with fibers, for which the reinforcing material is made of synthetic fibers.

Tiles generally have as their main ingredients clay and cement, and are installed one after another along the slope of a roof from the eaves to the ridge. At that time, the edge toward the ridge of a tile that is placed at the edge of the eaves has placed on the edge toward the eaves of the next tile. Each tile is supported by the attachment of the edge of the tile toward the ridge to the underlying building material such as flat boards, roofing, or the like, and by the placement of the edge of the tile toward the eaves on the top of the edge toward the ridge of the next tile. Thus, the edge of each tile toward the eaves is placed in a higher position with respect to the building material under the tiles than the edge of that tile toward the ridge, resulting in a space between the underneath surface of the tile and said building materials under the tiles. For that reason, when a load is placed on the central part of tiles installed in such a way on a roof, bending stress affects this central part, and gives rise to the danger of breakage of the tiles.

In order to prevent this kind of bending stress, the entire body of the tile can be made thick. However, if the entire body of the tile is made thick, the weight of the tile itself increases, which makes the tile costly. Moreover, the work load at the time of the installation of the tiles on the roof is increased, and there is an additional disadvantage that the durability of the building itself is decreased.

For these reasons, in order to increase the strength of the tiles, and also to increase the ease of the operation of the formation of the tiles, asbestos fibers have been mixed in as a reinforcing material. For example, in wave-shaped tiles with alternating hills and valleys, a mixture made of cement, asbestos, pulp, and the like in water is used to make a form in a cement mold like the process of making hand-made paper, and this is formed with pressure in a liquid roller, etc., in a so-called paper-making process, by which the hills and valleys are formed with approximately the same thickness.

However, in recent years, it has been found that asbestos fibers are a carcinogenic material, and so there are problems with the use of asbestos fibers. For that reason, in place of asbestos fibers, inorganic fibers such as glass fibers, inorganic fibers such as potassium titanate fibers, etc., organic fibers such as vinylon, acrylonitrile, polypropylene, polyamide, etc., or metallic fibers such as steel fibers, etc., have been developed for the use in tiles made of cement as reinforcing materials. For example, tiles made of a cement in which short fibers of polyester, glass, etc., as reinforcing materials are disclosed in Japanese Patent Publication No. 57-9009.

In this kind of tile made from cement reinforced with fibers, the tiles are light-weight, so their production is made easier, and another advantage is the high strength conferred. However, with this kind of tile, the hardness is slightly decreased, and as mentioned above, when the tiles are installed on a roof and there is a load placed on the central part of the tiles, the tiles are largely deformed, and stress accumulates in the center part of the tiles, bringing about the possibility that the tiles will break.

Also, in a wave-shaped tile formed with alternating hills and valleys, when the tile is installed with its hills and valleys running along the slope of a roof, and when a load is placed on the upper surface of the tile, it is known that more force is exerted on the valleys than on the hills. Tiles with this kind of shape are generally made with the hills and valleys of approximately the same thickness, so that when a large load is placed on the valleys, there is the disadvantage of the valleys being easily broken.

Japanese Laid-Open Patent Application 58-213666 discloses a molding method that gives tiles made of cement and reinforced with fibers, wherein an inorganic filler and synthetic fibers are mixed with cement and 15-30 parts by weight of water per 100 parts by weight of the cement are added and kneaded by a kneader in which the surfaces of the fibers scratched, after which the amount of water needed for the formation of the particular shape is added, and molding is accomplished by, for example, the use of a press. Kneaders that have sharp protuberances in the kneading chamber, pressure kneaders, pulpers, or the like can be used.

However, with this kind of method, the synthetic fibers may come to be twisted around each other, and there is the chance of their forming a fiber ball. In general, the chance of synthetic fibers becoming twisted around each other is greater than for asbestos fibers. Once a fiber ball has been formed, it is not easy to undo said ball, so there is a tendency for the synthetic fibers to be distributed unevenly in the cement matrix. Scratches are made in synthetic fibers in the kneader, so the strength of the said synthetic fibers themselves may be decreased. The result is that the molded products may not have the desired strength.

Also, when a mixture that contains 30 parts by weight or more of water is molded under pressure, there may be separation out of the water portion in the mold before molding is complete. The result is that this mixture is not completely molded, and there is the possibility that the strength of the molded product will not be uniform.

The tile made of cement reinforced with fibers of this invention which overcomes the above-discussed and numerous other disadvantages and deficiencies of the prior art, has, per 100 parts by weight of cement, 0.3-7 parts by weight of synthetic fibers as reinforcing materials, and 200 parts by weight or less of an inorganic filler, wherein said tile has a wave-shape with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

In a preferred embodiment, the supporting stand, when the tile is installed on the building material of the roof that is under the tile, has a length y along the direction of the slope of the said building material under the tile, a length x at right angles to the said direction of the slope, and a maximum height h wherein $y \geqq 3$ mm, $x \geqq 3$ mm, and $h \leqq 60$ mm.

The method for the manufacture of tiles made of cement reinforced with fibers of this invention comprises the mixing of 200 parts by weight of an inorganic filler with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with 100 parts by weight of cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers.

Alternatively, the method of this invention comprises the mixing of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in a desired tile reinforced with fibers wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when the tile is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

Alternatively, the method of this invention comprises the mixing of some of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining inorganic filler and the remaining cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers, wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed or the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

Alternatively, the method of this invention comprises the mixing of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with some of 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining synthetic fibers and 100 parts by weight of cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers, wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed or the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

Thus, the invention described herein makes possible the objectives of (1) providing light-weight tiles with improved strength by which the tiles are not readily broken even when a weight is put thereon; and a method for the manufacture of tiles made of cement reinforced with fibers by which synthetic fibers that function as a reinforcing material are not damaged and cut, and accordingly are uniformly dispersed into the cement matrix.

This invention may be better understood and its numerous objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawings as follows:

Figure **1** is a perspective view showing a tile of this invention.

Figure **2** is a front view showing the disposition of one tile on another tile manufactured by this invention.

Figure **3** is a perspective view illustrating an experiment on the resistance to loading of a tile of this invention.

Figure **4** is a perspective view showing another tile of this invention.

Figure **5** is a sectional view showing the installation of tiles of Figure **4** on a roof.

Figure **6** is a perspective view showing another tile of this invention.

Figure **7** is a perspective view showing another tile of this invention.

Figure **1** shows a tile of this invention made of cement reinforced with fibers. The tile **1** is made from cement reinforced with fibers in which there are mixed, per 100 parts by weight of cement, 0.3-7 parts by weight of synthetic fibers as a reinforcing material, and 200 parts by weight or less of an inorganic filler, which mixture is stretched out to form a shape with alternating hills **2** and valleys **3**. Each hill **2** and valley **3** is semicircular in cross-section; the thickness of the valleys, **m**, is 5-30% more than the thickness ℓ of the hills **3**. Also, the percentage of curve of the upper and lower surfaces of each valley **3** is approximately the same. For this reason, for example, as shown in Figure **2**, when two of the same tiles **1** are placed one over the other, the bottom surface of the valleys **3** of the upper tile **1** and the top surface of the valleys **3** of the lower tile **1** touch each other. The result is that when a large number of tiles are placed one on the top of the other for shipping, each tile is protected, and there is no danger of breakage.

This kind of tile **1** is put on the top of the building material under the tiles provided on the roof, and the tiles are placed so that the hills **2** and the valleys **3** of the tile run in the direction of the slope of the said roof. The tiles **1** are placed one after another from the bottom, the eaves side, to the top, the ridge side of the roof. At this time, the top of the ridge-side edge of a tile placed at the edge of the eaves has placed on the eaves-side edge of another tile. Because the valley parts of the tiles that are placed on the top of each other fit together as described above, the leakage of rainwater and the like under the tiles is prevented.

The thickness **m** of the valleys **3** is 5-30% more than the thickness ℓ of the hills **2**. If the thickness **m** of the valleys **3** is more than 30% more than the thickness ℓ of the hills **2**, the strength against breakage of the hills declines markedly compared to the strength against breakage of the valleys **2**; also, if the thickness **m** of the valleys **3** is less than 5% more than the thickness ℓ of the hills **2**, the strength against breakage of the valleys **3** is not sufficient.

As cements that can be used for the tiles of this invention, Portland cement, alumina cement, blast furnace cement, and other hydraulic cements can be used.

As the synthetic fibers, there are vinylon, polyamide, polyester, polypropylene, and other fibers, the thickness of which can be 2-40 deniers, and the length of which can be 2-30 mm.

The amount of synthetic fibers to be added is 0.3-7 parts by weight. If the amount of synthetic fibers added is too small, the effect of reinforcement will not appear, and if the amount of synthetic fibers added is too large, the distribution of the said fibers will become poor, which decreases the flow during the time of molding, so that the effect of reinforcement by the said fibers will not appear. As the synthetic fibers, vinylon fibers are especially suitable because their flow characteristics are good, giving good formability.

As inorganic filler, silica, river sand, fly ash, silica flour, bentonite, sepiolite, wollastonite, calcium carbonate, mica, and so on can be listed.

For satisfactory distribution of the inorganic filler and synthetic fibers in the cement, a water-soluble polymer is used, if necessary. When the inorganic filler and synthetic fibers can be distributed in the cement satisfactorily by themselves, the addition of the said water-soluble polymer is not necessarily required.

As the water-soluble polymer, methyl cellulose, carboxymethylcellulose, polyvinyl alcohol, hydroxyethylcellulose, polyacrylic acid, etc., are suitable. The said water-soluble polymers act to disperse aggregates and synthetic fibers such as vinylon fibers and the like uniformly throughout the cement, and can be added to prevent the formation of fiber balls made by the precipitation of aggregates or by the mutual twisting together of the said fibers, for which purpose 1 part by weight or less can be added.

Also, for the preparation of the composition from which cement tiles are obtained, the method of mixture by agitation can be used. In this method, agitation blades are not used, but instead, agitation involves the use of an apparatus to which is attached a vessel made of rubber that is pliable and is in the form of a disc-shaped agitating platform; the direction of the inclination of the agitating platform and the angle of the inclination can be continuously changed, so that the rubber vessel in which the materials to be mixed are placed is deformed and agitated, mixing them.

As the apparatus for mixture by agitation, for example, the Omuni mixer of the Chiyoda Giken Kogyo Co. can be used.

The tile of this invention is made from, for example, 100 parts by weight of cement, 30 parts by weight of fly ash, 2 parts by weight of vinylon fibers as the synthetic fibers, and 40 parts by weight of water, which are mixed to produce a cement composition that is reinforced with fiber, and the desired shape is formed by the use of a water-removing press on the said fiber-reinforced cement composition, after which the resulting molded product is heated at 60°C and at the relative humidity of 95% in a steam room for 24 hours for steam curing.

In this way, a tile with four pairs of hills **2** having a thickness of 6 mm each and valleys **3** having a thickness of 7 mm each, which thickness is 16% thicker than the thickness of the hills, was obtained, and a test of resistance to loading was done. The experiment on the resistance to loading involved, as shown in Figure **3**, a tile **1** with valleys **3**, the edges of which were both supported by a pair of supporting rods **5**; a load point **6** was put on the central portion of one of the hills **2** in the central part of the tile **1**, and the load on this point when the tile **1** broke was measured. The size of the load point **6** was 70 mm x 70 mm.

The load resisted at the time of breakage of the tile **1** of this experiment was 240 kg. For comparison, a reference tile was made in the same way as in the method of this invention, except that the thickness of the hills and valleys was a uniform 6 mm, and a test of resistance to loading was done. The load resisted at the time of breakage of the reference tile was 180 kg. Moreover, a tile was made in the same way as in the method of this invention, except that the thickness of the hills and the valleys was a uniform 7 mm, and a test of resistance to leading was done. The load that was resisted at the time of breakage of the second reference tile was 240 kg, the same as the value found for the tile of this invention.

In this way, when the thickness of the valleys was made thicker by a fixed amount than the thickness of the hills, it was found that the tile had the same resistance to a load as a tile that had hills with the same thickness as the thickness of the valleys on our tile. As a result, compared to a tile in which the thickness of the valleys and hills is uniform, it is possible to decrease the weight and cost of materials by the difference in the thickness of the hills. Thus, the tile cf this invention is economical, and because the tile is relatively light-weight, the operation of installing the tile on a roof is eased.

Figure 4 shows another tile of this invention. This tile **10** also is formed in a wave shape so that when it is installed on a roof, there are alternate hills **14** and valleys **15** that follow the direction of the slope of the roof; in cross-section, the shape of each hill **14** and each valley **15** is a rectangle. When each tile **10** is installed on a roof, then, as shown in Figure **5**, the eaves-side edge **12** of the tile **10** is placed on the ridge-side edge of the next tile **10**.

The said tile **10** has at its edge that is placed on the eaves side at the time of installation on the roof a downward-projecting part **13** that projects downward (in Figure **4**, it is shown projecting upward), which is provided continuously along each hill **14** and each valley **15**. On the underside of this edge toward the eaves, there is a parallel groove **16** with a fixed distance from the said downward projecting part **13**. The groove **16** is provided continuously along each hill **14** and each valley **15**.

At the edge of the tile **10** that is placed toward the ridge at the time of roofing, there is an upward-projecting part **17** that projects upward. The upward-projecting part **17** is provided continuously along each hill **14** and each valley **15**, and is fitted with the groove **16** mentioned above along the edge of the tile toward the eaves. On the upper side of the edge of the tile toward the ridge, there is a groove **18** that is parallel at a fixed distance from the said projection **16**. The groove **18** is provided continuously along each hill **14** and each valley **15**, and the projection **13** that is established along the eaves side, as mentioned above, fits into the said groove **18**.

On the underside of each valley **15**, there are a pair of supporting stands **20** and **21** that project downward. The supporting stands **20** and **21** are both in the shape of a right-angled parallelepiped, and one of the supporting stands, **20**, is placed near the edge of the tile toward the eaves, and the other supporting stand, **21**, is placed near the edge of the tile toward the ridge. The position of the supporting stands **20** and **21**, at the time of roofing, corresponds to the main roof crosspiece that is under the building materials **19** of the roof that are under the tiles. The height of each of the supporting stands **20** and **21** is set so that the supporting stands **20** and **21** can touch or can have a space from the building materials **19** when the tiles **10** are installed on the top of the building materials **19** under the tiles on a roof, whereby the ridge-side edge of the tile **10** comes into contact with the building material **19**; the projection **13** on the eaves-side edge of the tile fits into the groove **18** on the ridge-side edge of the next tile that is placed toward the eaves; and moreover, the projection **17** on the ridge-side edge of the tile is fit into the groove **16** on the eaves-side edge of the next tile. The lower surfaces of the supporting stands **20** and **21** have the same slope as the building materials **19** placed under the tile **10**. Therefore, the height of the supporting stand **20** on the eaves side of the tile is greater than the height of the supporting stand **21** on the ridge side. The bottom surfaces of said supporting stand **20** and **21**, even when they are not directly connected with the building materials **19** under the tiles, come into direct contact with the building materials **19** under the tiles if a load is placed on the upper surface of the tile **10** and the tile **10** is deformed by the load.

The tile of this kind of shape, as in the tiles of the example given above, is also manufactured from a cement reinforced by fibers in which there are, per 100 parts of cement by weight, 0.3-7 parts by weight of synthetic fibers as reinforcing material, and 200 parts by weight or less of an inorganic filler. The supporting stands **20** and **21** are formed of the same material as the valleys and are made in one piece with the said valleys.

The supporting stands **20** and **21** for the tiles **10** undergo the same compressive stress as the ridge-side edge of a tile **10** when the ridge-side edge of the tile **10** installed at the ridge side is placed on the eaves-side edge of the next tile **10**. In general, cement that is reinforced with fibers has excellent strength against compression, but because the deformation of the tile **10** itself when a load is put on the said tile **10** must be minimized, the measurement **y** of the direction of the slope of the roof of the supporting stands **20** and **21** should be 3 mm or more, and the measurement **x** at right angles to that direction should be 3 mm or more, with the maximum height **h** being preferably 60 mm or less. If both the measurement **y** of the supporting stands **20** and **21** in the direction of the roof slope and the measurement **x** in the direction at right angles to that direction are smaller than 3 mm, then when the tile **10** is produced from a cement composition reinforced with fibers by use of press molding, not every part of the mold for the molding of the supporting stands **20** and **21** is filled satisfactorily with the composition, and gaps in the supporting stands **20** and **21** to be molded may occur. Sufficient resistance to loading cannot be obtained with the supporting stands that have these kinds of gaps. If the maximum height **h** of the supporting stands **20** and **21** exceeds 60 mm, in the same way, not every part of the mold for the molding of the supporting stands is filled satisfactorily with the composition, and sufficient resistance to loading may not be obtained.

If the measurement **x** of the supporting stands **20** and **21** in the direction at right angles to the direction of the slope of the roof is the same as that maximum height **h** or more ($\mathbf{x} \geqq \mathbf{h}$), then the cement composition reinforced with fibers can fill every part of the mold for the molding of the supporting stands, and the deformation of the supporting stands **20** and **21** in response to the loading of the tile **10** can be minimized. Moreover, if the measurement of the maximum height **h** of the supporting stands **20** and **21** is 2 mm or less, the deformation in response to a load on the tile **10** is large, which is not desirable.

The shapes of the supporting stands **20** and **21** are not limited to right-angled parallelepipeds; as shown in Figure **6**, they can be elliptical columns. In this case as well, it is preferable that the supporting stands **20** and **2** fulfill the conditions for measurements described above.

In this way, when a pair of supporting stands **20** and **21** are provided, one being near the eaves-side edge of the tile and the other being near the ridge-side edge thereof, if a load is placed on the tile **10**, the hills **14** and the valleys **15** between the supporting stands **20** and **21** undergo bending stress, but because the distance between the supporting stands is relatively short, there is no danger of breakage of the tile **10**. To support this kind of bending stress, there can be one supporting stand **22** that is in the shape of, for example, a right-angled parallelepiped, as shown in Figure **7**, which stretches from near the eaves-side edge to near the ridge-side edge.

Because the space between the undersurface of the valleys **15** and the building materials under the tile is smaller than the space between the undersurface of the hills **14** and the building materials under the tile, by the provision of a supporting stand on the undersurface of the said valley **15**, it is possible to make the measurements of the supporting stand small, so that the increase in the weight of the entire tile becomes small and economical.

When such a tile is installed on a roof, even if the upper surface of the tile is stepped on, there is no danger of the breaking of the said tile, which increases the ease of the roofing operation.

Moreover, together with the provision of a supporting stand on the undersurface of the valleys **15**, if the thickness of the valleys is made 5-30% thicker than the thickness of the hills, the strength of the tile is yet more increased, and if the upper surface of the tile is stepped on by a person, there is no danger of breakage.

Next, examples and comparative examples will be explained, in order to compare the strength of the tile of this invention that have supporting stands with the strength of conventional tiles.

Example 1

(1) Preparation of a composition for tiles made of cement reinforced with fibers:

Per 100 parts by weight of ordinary Portland cement, 45 parts by weight of water, 1.5 parts by weight of vinylon fibers (diameter, 18 μm; length, 4 mm) as synthetic fibers, and 50 parts by weight of fly ash as aggregate were mixed in an Omuni mixer by agitation, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Formation of tiles made of cement reinforced with fibers:

The composition described in Section 1 above was molded by a water-removing press, and as shown in Figure **6**, each valley was provided on its underside with a pair of supporting stands **20** and **21** of elliptical shape, giving a tile **10** made of cement reinforced with fibers.

The supporting stand **20** that was provided on the eaves-side ridge of the tile had a measurement **y** in the direction of the slope of the roof of 15 mm, a measurement **x** in the direction at right angles to that direction of 10 mm, and a measurement **h** for the maximum height of 15 mm; for the supporting stand **21** on the ridge-side edge, these measurements were 10 mm, 8 mm, and 7 mm, respectively.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:

Some of the tiles made of cement reinforced with fibers that were formed in Section 2 above were cut cross-sectionally, and the conditions of filling with the material for the supporting stands **20** and **21** were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:

Some of the tiles **10** made of cement reinforced with fibers that were formed in Section 2 above were cured by being placed in water for 14 days. Then they were installed on a roof, and a person bearing a weight walked on the tiles. The weight required for the tiles to break when stepped on by a person bearing a weight was measured; it was 160 kg.

Example 2

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:

Per 100 parts by weight of ordinary Portland cement, 45 parts by weight of water, 2.0 parts by weight of vinylon fibers (diameter, 18 μm;, length, 6 mm), 40 parts by weight of silica powder as aggregate, and 0.1 part by weight of methyl cellulose as a water-soluble polymer were mixed in the same way as in Example 1 by agitation in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Molding of tiles made of cement reinforced with fibers:

The composition described in Section 1 above was molded by a water-removing press to form tiles made of cement reinforced with fibers in the same shape as in Example 1.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:

In the same way as in Example 1, the condition of filling with material was observed, and it was found that filling of all places was satisfactory.

(4) Quality of tiles made of cement reinforced with fibers:

Some of the tiles **10** made of cement reinforced with fibers that were formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 180 kg.

Example 3

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of quick-hardening cement, 50 parts by weight of water, 2.5 parts by weight of vinylon fibers (diameter, 18 μm; length, 12 mm), 20 parts by weight of fly ash and 30 parts by weight of silica powder as aggregates, and 0.4 part by weight of methyl cellulose as a water-soluble polymer were mixed in the same way as in Example 1 by agitation in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press to form tiles made of cement reinforced with fibers in the same shape as in Example 1.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
In the same way as in Example 1, the condition of filling with material was observed, and it was found that filling of all places was satisfactory.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles **10** made of cement reinforced with fibers that were formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 230 kg.

Example 4

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of ordinary Portland cement, 45 part by weight of water, 1.5 parts by weight of vinylon fibers (diameter, 18 μm, length, 4 mm) and 50 parts by weight of fly ash as aggregate were agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with vinylon fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press to form the tiles **10** made of cement reinforced with fibers shown in Figure **7**, with single supporting stands 22 in the shape of right-angled parallelepipeds on the undersurfaces of valleys **15**.
The measurements of the supporting stand **22** were: **y**, the measurement in the direction of the slope of the roof, 300 mm; **x**, the measurement in the direction at right angles to this direction, 15 mm, and the maximum height **h**, 7 mm.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
Some of the tiles made of cement reinforced with fibers that were formed in Section 2 above were out cross-sectionally, and the conditions of filling with material for the supporting stand **22** were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles **10** formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 170 kg.

Example 5

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of ordinary Portland cement, 45 parts by weight of water, 2.0 parts by weight of vinylon fibers (diameter, 18 μm; length, 6 mm), 40 parts by weight of silica powder as aggregate, and 0.1 part by weight of methyl cellulose as a water-soluble polymer were mixed by being agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with vinylon fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press as in Example 4 to give tiles **10** made of cement reinforced with vinylon fibers, which tiles had a supporting stand **22** in the shape of a right-angled parallelepiped.

(3) Condition of filling a with material for tiles made of cement reinforced with fibers:
Some of the tiles made in Section 2 above were cut cross-sectionally, and the conditions of filling with material for the supporting stand **22** in the shape of a right-angled parallelepiped were observed. It was found

that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles **10** formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 4, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 200 kg.

Example 6

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of quick-hardening cement, 50 parts by weight of water, 2.5 parts by weight of vinylon fibers (diameter, 18 µm, length, 12 mm), 20 parts by weight of fly ash and 30 parts by weight of silica powder as aggregates, and 0.4 part by weight of methyl cellulose as a water-soluble polymer were mixed by being agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press to form tiles made of cement reinforced with fibers in the same shape as in Example 4, with one supporting stand **22** in the shape of a right-angled parallelepiped, giving tiles **10** made of cement reinforced with vinylon fibers.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
Some of the tiles **10** formed in Section 2 above were cut cross-sectionally, and the conditions of filling with material for the supporting stand **11** were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles **10** formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 4, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 220 kg.

Comparative Example 1

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of ordinary Portland cement, 45 parts by weight of water, 1.5 parts by weight of vinylon fibers (diameter, 18 µm: length, 4 mm), and 50 parts by weight of fly ash as aggregate were mixed by being agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition obtained in Section 1 above was molded by a water-removing press, and tiles made of cement reinforced with fibers were formed into a wave shape in which there were absolutely no supports formed on the undersurface.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
Some of the tiles formed of cement in Section 2 above were cut cross-sectionally, and the conditions of filling with material were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles **10** formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 60 kg.

Comparative Example 2

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of ordinary Portland cement, 45 parts by weight of water, 2.0 parts by weight of vinylon fibers (diameter, 18 µm; length, 4 mm), 40 parts by weight of silica powder as aggregate, and 0.1 part by weight of methyl cellulose as a water-soluble polymer were mixed by being agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers.

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press to form tiles made of cement reinforced with fibers in the same shape as in Comparative Example 1.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
Some of the tiles formed in Section 2 above were cut cross-sectionally, and the conditions of filling with material were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality cf tiles made of cement reinforced with fibers:
Some of the tiles 10 formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 90 kg.

Comparative Example 3

(1) Preparation of a composition for use in the making of tiles made of cement reinforced with fibers:
Per 100 parts by weight of ordinary Portland cement, 50 parts of water by weight, 2.5 parts by weight of vinylon fibers (diameter, 18 µm, length, 12 mm), 20 parts by weight of fly ash and 30 parts by weight of silica powder as aggregates, and 0.4 part by weight of methyl cellulose as a water-soluble polymer were mixed by being agitated in an Omuni mixer, which gave a composition for use in the making of tiles made of cement reinforced with fibers:

(2) Molding of tiles made of cement reinforced with fibers:
The composition described in Section 1 above was molded by a water-removing press to form tiles made of cement reinforced with fibers in the same shape as in Comparative Example 1.

(3) Condition of filling with material for tiles made of cement reinforced with fibers:
Some of the tiles formed in Section 2 above were cut cross-sectionally, and the conditions of filling with material were observed in cross-section. It was found that filling was satisfactory in every place.

(4) Quality of tiles made of cement reinforced with fibers:
Some of the tiles formed in Section 2 above were cured by being placed in water for 14 days. Then, in the same way as in Example 1, the weight required for the tiles to break when stepped on by a person bearing a weight was measured. It was 100 kg.

In all of the examples including the comparative examples, the shapes and the measurements of the tiles were exactly alike, except that the tiles of this invention were provided with supporting stands while the tiles of the comparative examples were not provided with supporting stands.

The compositions of the examples and the comparative examples given above are shown in Table 1, as are the shapes, measurements, numbers, and filling condition by the compositions of the supporting stands, together with the results of the weight-bearing test.

Table 1

		Composition (parts by weight)						
		Ordinary cement	Quick-hardening cement	Water	Vinylon fibers	Fly ash	Silica powder	Methyl cellulose
Examples	1	100	——	45	1.5	50	——	——
	2	100	——	45	2.0	——	40	0.1
	3	——	100	50	2.5	20	30	0.4
	4	100	——	45	1.5	50	——	——
	5	100	——	45	2.0	——	40	0.1
	6	——	100	50	2.5	20	30	0.4
Comparative examples	1	100	——	45	1.5	50	——	——
	2	100	——	45	2.0	——	40	0.1
	3	——	100	50	2.5	20	30	0.4

Table 2

	Shape, numbers, and measurements of supporting stands								Condition of filling	Weight-bearing test(kg)
	Shape	Numbers	Measurements 1 (mm)			Measurements 2 (mm)				
			x	y	h	x	y	h		
Example 1	Elliptical	6	10	15	15	8	10	7	Good	160
Example 2	Elliptical	6	10	15	15	8	10	7	Good	180
Example 3	Elliptical	6	10	15	15	8	10	7	Good	230
Example 4	Rectangular	3	15	300	7	—	—	—	Good	170
Example 5	Rectangular	3	15	300	7	—	—	—	Good	200
Example 6	Rectangular	3	15	300	7	—	—	—	Good	220
Comparative Example 1	—	—	—	—	—	—	—	—	Good	60
Comparative Example 2	—	—	—	—	—	—	—	—	Good	90
Comparative Example 3	—	—	—	—	—	—	—	—	Good	100

Note) Numbers: Numbers of supporting stands per tile made of cement.
Measurements: In the case of a valley with two supporting stands, Measurements 1 are the measurements of the supporting stand toward the ridge, and Measurements 2 are the measurements of the supporting stand toward the eaves.

In this way, when the measurement **y** of the supporting stands in the direction of the slope of the roof is ≧ 3 mm, the measurement **x** thereof in the direction at right angles to this direction is ≧ 3 mm, and the maximum height h thereof is ≦ 60 mm, the resistance to loading on the tile greatly increases.

Next, the method for production of the tiles made of cement reinforced with fibers of this invention will be explained. First, 1 part by weight or less of a water-soluble polymer is dissolved into 30 parts of water by weight or more, if needed, resulting in an aqueous solution containing the water-soluble polymer. To this aqueous solution (or an aqueous solution that is made while dissolving the said compound into the said water), 200 parts by weight or less of an inorganic filler is added and mixed, to which 0.3-7 parts by weight of synthetic fibers is added and mixed in by agitation. In this way, the synthetic fibers are not damaged or broken, and they can therefore be uniformly dispersed in the mixture. In these circumstances, if the mean diameter of the inorganic filler particles is more than 100 μm, it is difficult for the particles to enter in the fiber spaces between the synthetic fibers, and there is thus a tendency for the particles to aggregate, so it is preferable for the mean diameter of particles of the inorganic filler to be 100 μm or less. If the amount of synthetic fibers added is less than 0.3 part by weight, sufficient strength is not obtained at the time of molding of the tiles. If the amount of synthetic fibers added is more than 7 parts by weight, the dispersion of the fibers becomes poor, and flowability is also poor at the time of molding of the tiles.

Then, to the mixture obtained above, 100 parts by weight of cement is added and mixed in by agitation, thereby attaining the dispersion of the fine particles of cement in the spaces between the inorganic filler and the synthetic fibers.

Then, the mixture obtained above is put into a mold that can be opened and closed, and the desired shape is formed by the application of pressure. At this time, the mixture with 30 parts by weight of water or more readily undergoes the separation out of water. For this reason, it is necessary that the molding of the tile be completed before the separation out of water occurs. If the rate of pressure of the mixture in the mold is 0.3 mm/sec or more, there is no separation out of the water, and the desired shape can be made perfectly, as the entire mold is rapidly filled with the mixture.

A certain amount of water is removed from the molded product within the mold so that the molded product can keep its shape, after which it is removed from the mold, and cured and hardened by the well-known method. In this way, a tile of the desired shape is obtained.

With this kind of method for the manufacture of tiles, even if part of the cement is added during the first step, the synthetic fibers are not damaged or broken in the first step, and can be mixed in uniformly. Then, even if the remaining cement to be added is added in the second step, the dispersion of the fine particles of cement in the spaces between the inorganic filler and the synthetic fibers is readily attained. Also, even if part of the cement and part of the aggregate are added during the first step, the synthetic fibers are not damaged or broken in the first step, and uniform mixing can be attained. And, if the remaining part of the cement and the remaining part of the aggregate are added in the second step, it is still easy for the fine particles of cement to be dispersed in the spaces between the inorganic filler and the synthetic fibers.

In addition, if some of the synthetic fibers are added in the first step, and if the remaining synthetic fibers are added in the second step, the synthetic fibers are not damaged or broken, and uniform mixing can be attained. In this case, the fine particles of cement can easily be dispersed in the spaces between the inorganic filler and the synthetic fibers.

Next, the method of this invention will be explained by other examples of the manufacture of the above-mentioned tiles made of cement reinforced with fibers.

Example 7

To 30 parts by weight of water, 0.1 part by weight of methyl cellulose and 0.3 part by weight of vinylon fibers (fiber length, 6 mm; thickness, 5 deniers) as synthetic fibers were added, and these were mixed by being agitated in an Omuni mixer with a 5-ℓ capacity manufactured by Chiyoda Giken Kogyo Co. To this mixture, 100 parts by weight of cement was added, and mixing by agitation was done again. This mixture was molded by a water-removing press at the surface pressure of 65 kg/cm^2 and the rate of pressure of 3 mm/sec resulting in a tile. The tile was cured at 60°C and a relative humidity of 90% for one week. The condition of dispersal of the fibers before molding, the surface of the cured tile, and the strength against being bent were observed. These results are shown in Table 3, wherein the evaluation of the dispersion of the vinylon fibers was graded as follows: ◯ means that the fibers were completely dispersed, with absolutely no agglutination of fibers, Δ means that dispersion was fairly complete but that some slight agglutination was observed, and X means that agglutination was marked.

Also, with the surface of the tiles, ◯ means that the surface was glossy, with fibers being uniformly dispersed, Δ means that there was uneveness of the surface, with some fibers not being uniformly dispersed, and X means that the surface was uneven, and the fibers were dispersed without uniformity. The strength against being bent was measured according to the methods of JIS 1048U.

Example 8

To 40 parts by weight of water, 0.2 part by weight of methyl cellulose, 30 parts by weight of fly ash (mean particle diameter, 100 μm), and 2.0 parts by weight of vinylon fibers were added, and these were mixed by agitation, after which 100 parts by weight of cement was added to this mixture, and mixed by agitation, with other steps being carried out as in Example 1. The results are shown in Table 3.

Example 9

A test was done of the same way as in Example 8 except that instead of the fly ash, silica (mean diameter, 100 μm) was used. The results are shown in Table 3.

Example 10

A test was done of the same way as in Example 8 except that instead of the fly ash, slag (mean diameter, 100 μm) was used. The results are shown in Table 3.

Example 11

A test was done of the same way as in Example 8 except that instead of the fly ash, silica flour (mean diameter, 100 μm) was used. The results are shown in Table 3.

Example 12

A test was done of the same way as in Example 8 except that instead of the fly ash, bentonite (mean diameter, 100 μm) was used. The results are shown in Table 3.

Example 13

A test was done of the same way as in Example 8 except that instead of the methyl cellulose, polyvinyl alcohol was used. The results are shown in Table 3.

Example 14

A test was done of the same way as in Example 8 except that instead of the methyl cellulose, hydroxyethylcellulose was used. The results are shown in Table 3.

Example 15

A test was done of the same way as in Example 8 except that instead of there being 0.2 part by weight of methyl cellulose, there were 2.0 parts by weight. The results are shown in Table 3.

Example 16

A test was done in the same way as in Example 7 except that per 150 parts by weight of water, 1.0 part by weight of methyl cellulose, 200 parts by weight of fly ash (mean particle diameter, 100 μm), and 7.0 parts by weight of vinylon fiber were added, and the whole was mixed by agitation. The results are shown in Table 3.

Example 17

A test was done in the same way as in Example 8 except that the rate of pressure was 5 mm/second. The results are shown in Table 3.

Example 18

A test was done in the same way as in Example 8 except that the rate of pressure was 7.5 mm/second. The results are shown in Table 3.

Example 19

A test was done in the same way as in Example 7 except that per 30 parts of water, methyl cellulose was not added, but 30 parts by weight of fly ash, 10 parts by weight of cement, and 0.5 part by weight of vinylon fibers were added and mixed by agitation; to this mixture, 90 parts by weight of the cement was added, and mixing by agitation was done once more. The results are shown in Table 3.

Example 20

A test was done in the same way as in Example 7 except that per 40 parts of water, methyl cellulose was not added, but 20 parts by weight of fly ash (mean particle diameter, 100 μm), 10 parts by weight of cement, and 2.2 parts by weight of vinylon fibers were added and mixed by agitation; to this mixture, 20 parts by weight of fly ash (mean particle diameter, 100 μm) and 90 parts by weight of cement were added, and mixing by agitation was done once more. The results are shown in Table 3.

Example 21

A test was done in the same way as in Example 7 except that per 40 parts of water, methyl cellulose was not added, but 30 parts by weight of silica (mean particle diameter, 100 μm), 10 parts by weight of cement, and l.2 parts by weight of vinylon fibers were added and mixed by agitation; to this mixture, 1.0 part by weight of vinylon fibers and 100 parts by weight of cement were added, and mixing by agitation was done once more. The results are shown in Table 3.

Comparative Example 4

A test was done in the same way as in Example 7 except that the amount of vinylon fibers used was 0.2 part by weight. The results are shown in Table 3.

Comparative Example 5

A test was done in the same way as in Example 7 except that per 150 parts of water by weight, 0.2 part by weight of methyl cellulose and 200 parts by weight of fly ash (mean particle diameter, 100 μm) were added and mixing was done by agitation. The results are shown in Table 3.

Comparative Example 6

A test was done in the same way as in Example 7 except that per 150 parts by weight of water, 0.2 part by weight of methyl cellulose, 220 parts by weight of fly ash (mean particle diameter, 100 μm), and 2.0 parts by weight of vinylon fibers were added and mixed by agitation; to this mixture, 100 parts by weight of cement was added and mixing by agitation was done once more. The results are shown in Table 3.

Comparative Example 7

A test was done in the same way as in Example 8 except that instead of mixing being done by agitation, a mixer with blades was used. The results are shown in Table 3.

It is seen from Table 3 that according to the method of this invention, tiles with superior strength against being bent are obtained, and that the said tiles are not readily broken when a weight is put on their upper surfaces, so the said tiles ease the operation of roofing when the tiles are being installed on a roof.

Table 3-1

		Example 7	Example 8	Example 9	Example 10	Example 11	Example 12	Example 13	Example 14	Example 15	Example 16
	Cement	100	100	100	100	100	100	100	100	100	100
	Vinylon (6 mm long, 5 denier thick)	0.3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	7.0
Inorganic filler	Fly ash (mean particle diameter 100 µm)		30					30	30	30	200
	Silica (mean particle diameter 100 µm)			30							
	Slag (mean particle diameter 100µm)				30						
	Silica flour (mean particle diameter 100 µm)					30					
	Bentonite (mean particle diameter 100 µm)						30				
Water-soluble polymer	Methyl cellulose	0.1	0.2	0.2	0.2	0.2	0.2			2.0	1.0
	Polyvinyl alkohol							0.2			
	Hydroxy ethyl cellulose								0.2		
Water		30	40	40	40	40	40	40	40	40	150
Mixer		Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer
Dispersion of vinylon fibers		○	○	○	○	○	○	○	○	○	○
Surface of molded tile		○	○	○	○	○	○	○	○	○	○
Rate of water-removing press (mm/sec.)		3	3	3	3	3	3	3	3	3	3
Strength against bending		162	275	310	301	295	290	265	270	300	195

Table 3-2

		Example 17	Example 18	Example 19	Example 20	Example 21	Comparative 4 Exam.	Comparative 5 Exam.	Comparative 6 Exam.	Comparative 7 Exam.
	Cement	100	100	100	100	100	100	100	100	100
	Vinylon (6 mm long, 5 denier thick)	2.0	2.0	0.5	2.2	2.2	0.2	7.5	2.0	2.0
Inorganic filler	Fly ash (mean particle diameter 100 μm)	30	30	30	30			200	220	30
	Silica (mean particle diameter 100 μm)					30				
	Slag (mean particle diameter 100 μm)									
	Silica flour (mean particle diameter 100 μm)									
	Bentonite (mean particle diameter 100 μm)									
Water-soluble polymer	Methyl cellulose	0.2	0.2				0.1	0.2	0.2	0.2
	Polyvinyl alcohol									
	Hydroxy ethyl cellulose									
Water		40	40	30	40	40	30	150	150	40
Mixer		Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Omuni mixer	Mixer with blades
Dispersion of vinylon fibers		○	○	○	○	○	○	×	○	×
Surface of molded tile		○	○	○	○	○	○	×	○	×
Rate of water-removing press (mm/sec.)		5	7.5	3	3	3	3	3	3	3
Strength against bending		285	286	151	255	260	120	125	140	135

It is understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be construed as encompassing all the features of patentable novelty that reside in the present invention, including all features that would be treated as equivalents thereof by those skilled in the art to which this invention pertains.

Claims

1. A tile made of cement reinforced with fibers having, per 100 parts by weight of cement, 0.3-7 parts by weight of synthetic fibers as reinforcing materials, and 200 parts by weight or less of an inorganic filler, wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

2. A tile according to claim 1, wherein said supporting stand, when the tile is installed on the building material of the roof that is under the tile, has a length **y** along the direction of the slope of the said building material under the tile, a length **x** at right angles to the said direction of the slope, and a maximum height **h** wherein $y \geqq 3$ mm, $x \geqq 3$ mm, and $h \leqq 60$ mm.

3. A method for the manufacture of tiles made of cement reinforced with fibers comprising the mixing of 200 parts by weight of an inorganic filler with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with 100 parts by weight of cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers.

4. A method for the manufacture of tiles made of cement reinforced with fibers comprising the mixing of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers wherein said tile is in the shape of a wave, with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

5. A method for the manufacture of tiles made of cement reinforced with fibers comprising the mixing of some of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining inorganic filler and the remaining cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers, wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

6. A method for the manufacture of tiles made of cement reinforced with fibers comprising the mixing of 200 parts by weight of an inorganic filler and some of 100 parts by weight of cement with an aqueous solution that has been or is being prepared by the dissolving of 1 part by weight or less of a water-soluble high polymer, if needed, into 30 parts by weight or more of water, the mixing by agitation of the mixture with some of 0.3-7 parts by weight of synthetic fibers, the mixing by agitation of the mixture with the remaining synthetic fibers and 100 parts by weight of cement, the putting of the mixture into a mold that can be opened and closed, and then the molding of the mixture at a rate of pressure of 0.3 mm/sec or more, resulting in the desired tile reinforced with fibers, wherein said tile is in the shape of a wave with alternating hills and valleys, which run in the direction of the slope of the roof when it is installed on the building material of the roof that is under the tiles of a sloping roof, the valley of the tile being 5-30% thicker than the hill, and/or the undersurface, except for the edges of the hills and valleys, being provided with a supporting stand.

Fig. 1

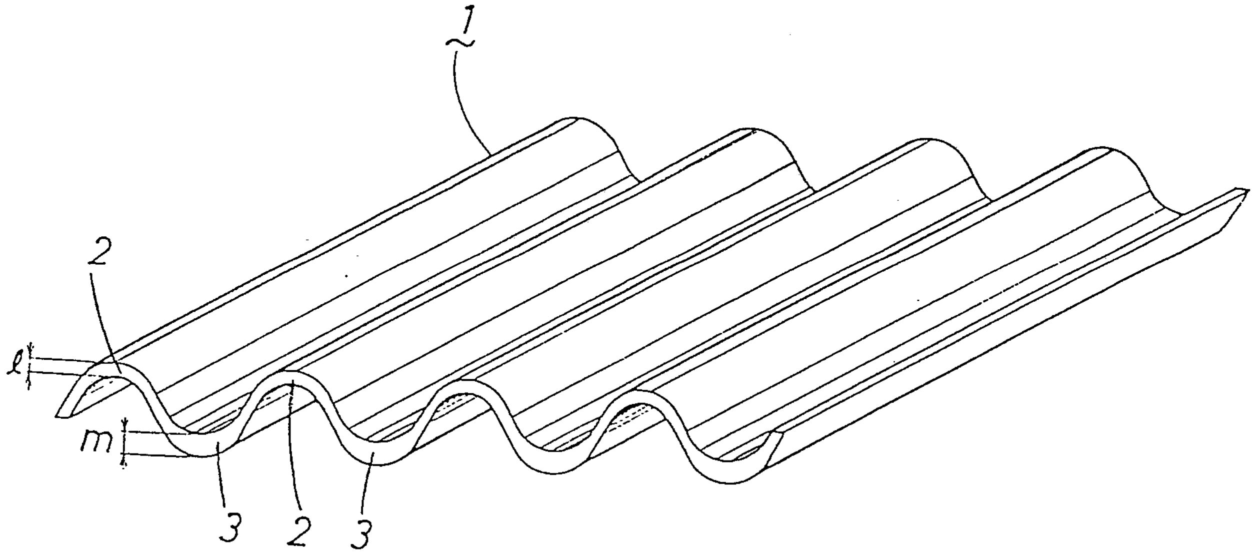

Fig. 2

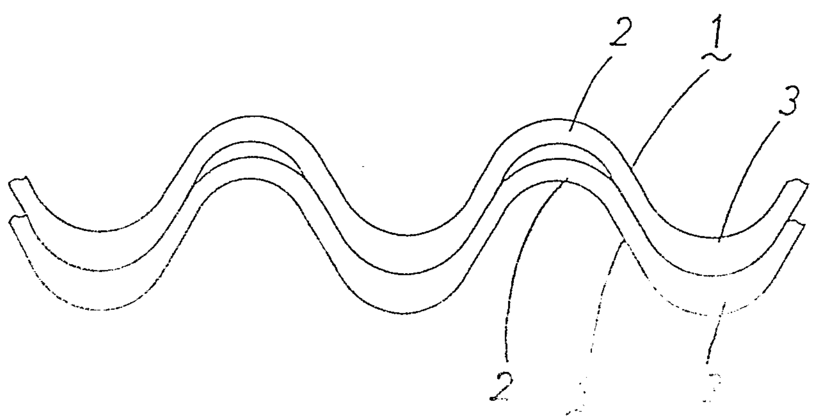

Fig. 3

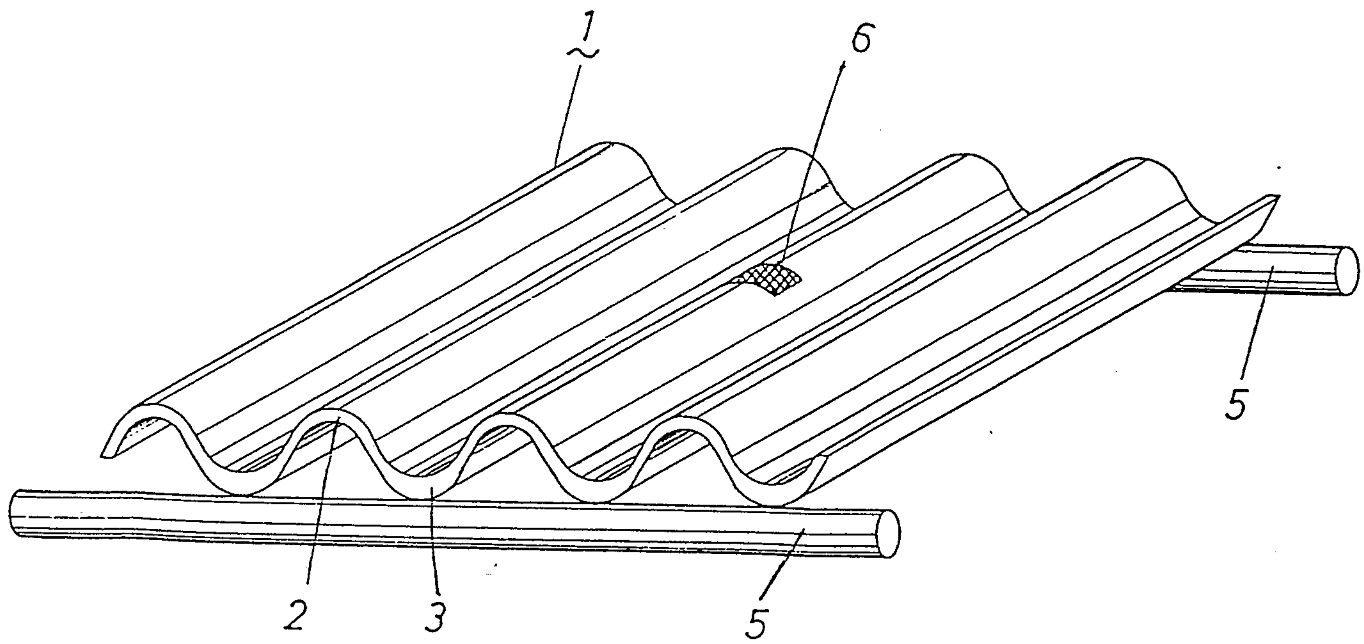

Fig. 4

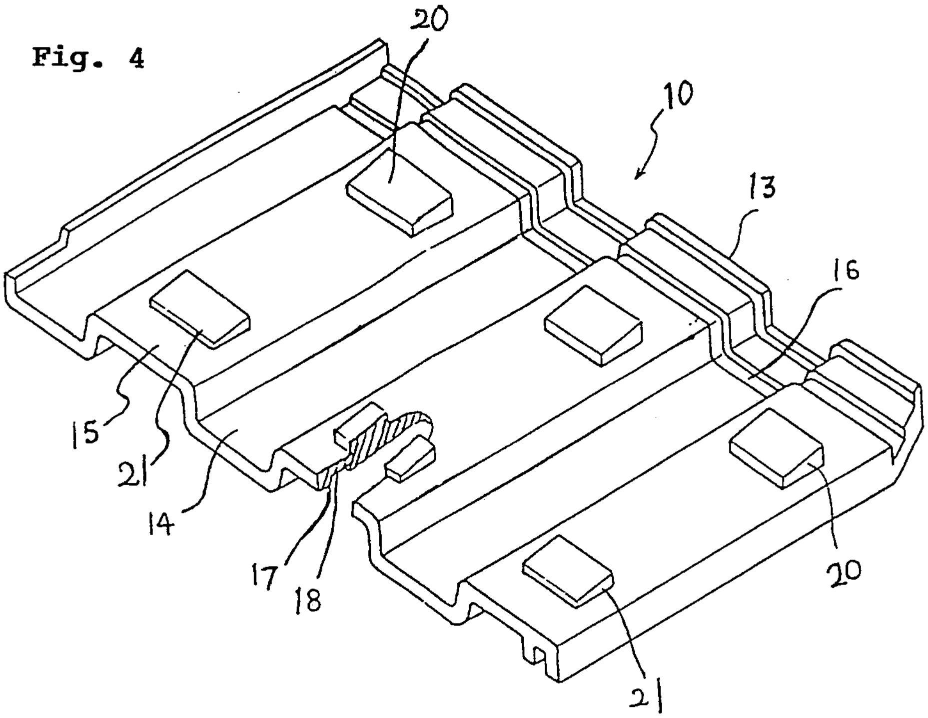
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Fig. 5

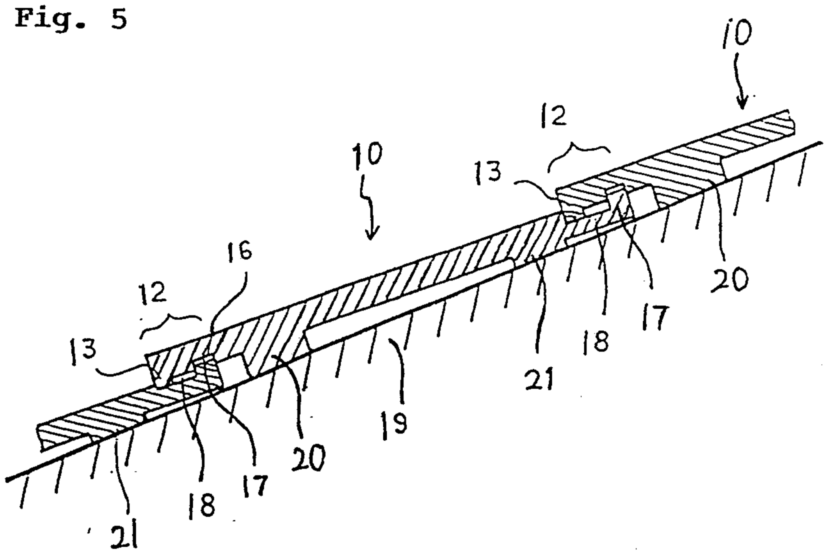
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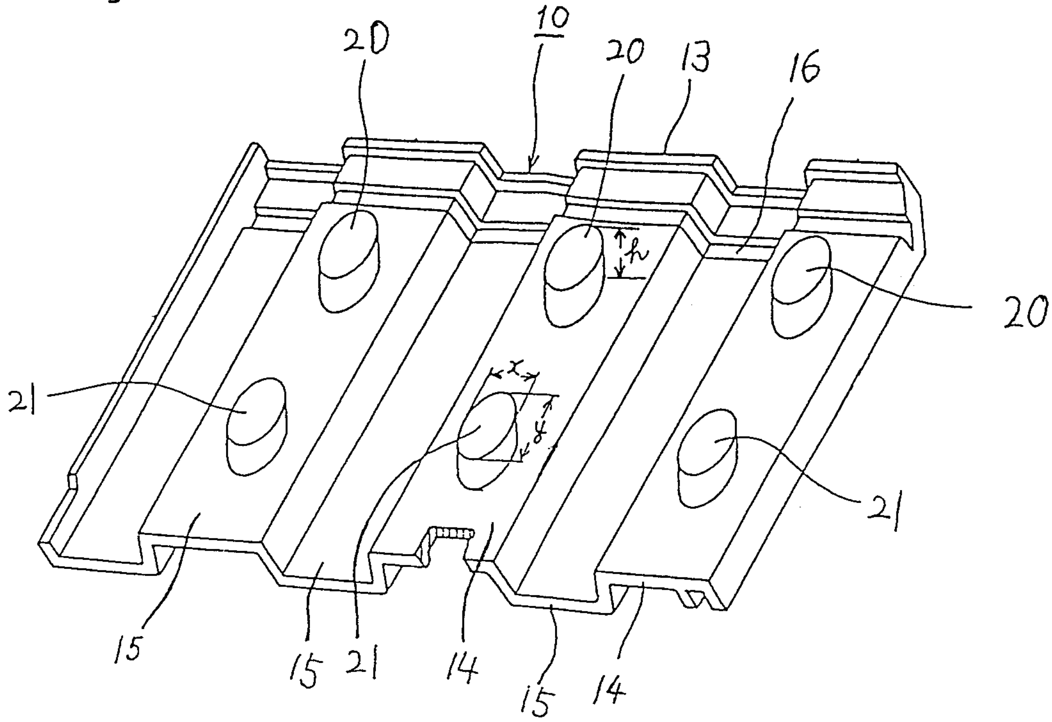
Fig. 6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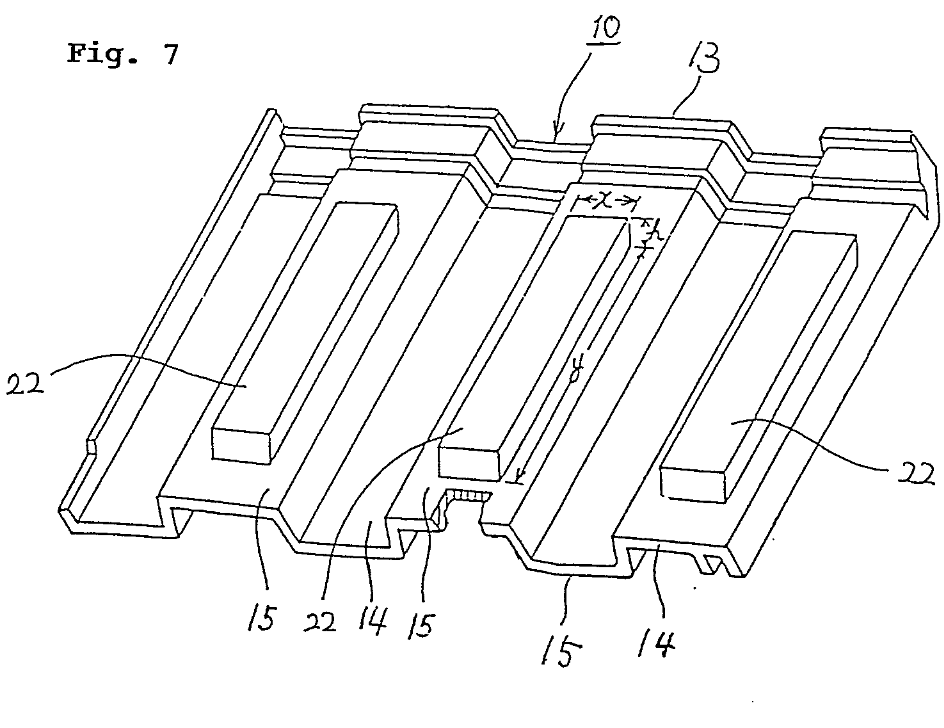
x
y
21
15
15
21
14
15
14

Fig. 7


10
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x
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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 5401

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	FR-A-2 286 254 (MARCHIOLI) * Page 2, line 35 - page 3, line 11; page 5, lines 25-33; page 7, lines 8-12; figure 1 * ---	1,2	E 04 D 3/26
Y	FR-A-1 010 876 (MAZELAYGUE et al.) * Whole document * ---	1,2	
A	US-A-3 224 205 (GREINER et al.) * Column 3, lines 25-39; column 5, lines 13-60; figures 1-4 * ---	1,2	
A	FR-A-1 371 646 (BRAAS & CO. GmbH) * Page 2, left-hand column, lines 20-39; figures 1-5 * ---	1,2	
A	EP-A-0 114 518 (IMPERIAL CHEMICAL INDUSTRIES PLC) * Page 2, line 21 - page 3, line 27; page 15, line 13 - page 16, line 3 * ---	1,3-6	
A	FR-A-2 370 010 (KUBOTA LTD) * Page 1, line 3 - page 3, line 7; page 4, line 31 - page 5, line 20 * ---	1,3-6	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-2 672 670 (RHODES) * Column 2, line 6 - column 5, line 54 * ---	1,3-6	E 04 D E 04 C B 28 B
A	FR-A-2 217 937 (FRAPART et al.) * Page 4, lines 19-29; page 6, line 17 - page 8, line 31; figure 1 * ---	1,3-6	
A	DE-A-2 743 934 (RAPONI) * Page 4, lines 8-15; page 8, line 26 - page 12, line 14 * --- -/-	1,3-6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-08-1988	BELTZUNG F.C.

CATEGORY OF CITED DOCUMENTS

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4 414 030 (RESTREPO) * Column 6, line 57 - column 8, line 7 * ---	1,3-6	
A	EP-A-0 173 553 (MARLEY TILE AG) * Page 15, line 4 - page 20, line 27 * -----	1,3-6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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